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Arduino based low-cost short-range terrestrial LiDAR Scanner

Cristiano Gygax, Marc-Henri Derron, and Michel Jaboyedoff

University of Lausanne, Geosciences and Environment, Lausanne, Switzerland

The search for low-cost equipment solutions in geomatics and other domains is a theme that is increasingly addressed by a growing number of researchers. Today, the open-source resources and the availability of cheap electronic equipment and easy to program microcontrollers to manage them (e.g. Arduino) make this type of research accessible to everyone.

The goal of this project is to assemble, program, test and evaluate a low-cost short-range terrestrial LiDAR scanner, i.e. a device that can scan a surface with a laser and represent it in 3D as a point-cloud. An initial prototype was assembled and programmed from low-cost electronics and mechanical components partly ordered and partly 3D printed, at a total cost of around USD 340. Conceptually, the operation of the device is simple: two stepper motors drive a laser sensor on two axes (horizontal and vertical), and a distance measurement for each of the motors positions is taken. These components are controlled by an Arduino Mega 2560, a powerful microcontroller known for its simplicity and versatility, which also receives the measurements and stores them on a SD card. A smartphone application was also developed to send scanning parameters to the LiDAR via Bluetooth. This first prototype detects on average 150 points/second at a maximum distance of about 40 m with an average error of 2 cm and a maximum resolution of less than 0.012° (1 point every 2.9 mm at a distance of 15 m).

Initial tests of the device in the laboratory and in the field are encouraging. In order to obtain a better-performing device, some mechanical components will be improved (to make the device more robust and reduce vibrations), a better-performing laser sensor installed (less error and higher maximum distance of at least 100 m) and a small solar panel coupled, so that the device can be tested in the field on several consecutive days.

This device will have two main applications: 1) it will be used for continuous monitoring in areas where the probability of destruction is too high to put a commercial device thousands of time more expensive; 2) it is planned to develop a DIY kit to be used by students in geosciences to understand the principles of laser scanning.